

What is claimed is:

1. Ultrasonic cutting apparatus comprising:
a conveyor assembly supporting a food product and transporting the food product in a forward direction;
a blade having first and second cutting edges on opposite ends thereof;
means for oscillating said blade ultrasonically; and
a reciprocating head supporting said blade, said reciprocating head being rectilinearly and transversely movable to effect formation of cuts in said food product by said first cutting edge when moving in a first transverse direction, and by said second cutting edge when moving in a second transverse direction.
2. The apparatus of claim 1 wherein said conveyor assembly comprises first and second conveyors arranged in series and an anvil disposed therebetween to constrain and support said food product during formation of transverse cuts, said anvil having a groove through which a portion of said blade travels .
3. The apparatus of claim 1 wherein the blade oscillates at a frequency of approximately 20,000 Hz.
4. The apparatus of claim 1 wherein the first cutting edge and the second edge intersect to form a tip.
5. The apparatus of claim 4 wherein the tip has a horizontal edge.
6. The apparatus of claim 5 wherein each of the cutting edges is inclined and intersects the horizontal edge of the tip at an obtuse angle.
7. The apparatus of claim 6 wherein the angles of intersection between the cutting edges and the horizontal edge of the tip are substantially identical.

8. The apparatus of claim 7 wherein the cutting edges define an included angle greater than 60 degrees and less than 90 degrees.

9. The apparatus of claim 8 wherein said included angle is about 60 degrees.

10. The apparatus of claim 1 wherein the blade has a linear translating velocity of at least about thirty inches per second and makes at least about 150 cuts per minute.

11. A device for cutting food product comprising:
a conveyor displacing food product in an input direction;
a frame disposed in a fixed location relative to the conveyor;
a carriage translatable secured to the frame and movable in a direction transverse to the direction of movement of the food product, the carriage including:
a blade; and
a head with the blade mounted thereto, the head providing ultrasonic mechanical vibration to the blade, wherein the blade has a first cutting edge and a second cutting edge, the blade translates transversely through the food product in a first direction thereby making a first cut in the food product with the first cutting edge, and the blade translates transversely through the food product in a second direction opposite the first direction thereby making a second cut in the food product with the second cutting edge.

12. The device of claim 11 wherein the conveyor includes conveyor sections separated by a gap, and wherein the device further comprises an anvil joining the conveyor sections.

13. The device of claim 12 wherein food product passes the anvil as the food product is displaced by the conveyor, and wherein the anvil includes

restraining fixtures for constraining movement of the food product in directions other than the input direction.

14. The device of claim 13 wherein the restraining fixtures are rotating elements with a line contact with the food product.

15. The device of claim 12 wherein the anvil includes a channel permitting a lower tip of the blade to pass through the channel and pass below a bottom surface of the food product.

16. The device of claim 11 wherein the frame is a substantially rigid cantilever.

17. The device of claim 11 wherein the frame is secured to a base.

18. The device of claim 11 wherein the frame includes at least one rail for guiding lateral translation of the carriage.

19. The device of claim 18 wherein the carriage includes a slide translatably secured on each rail.

20. The device of claim 19 including at least one drive slide to which translating force is provided, and at least a drive rail to which the drive slide is translatably secured.

21. The device of claim 11 wherein the head includes a signal generator for generating mechanical oscillation and an amplifier in communication with the signal generator, wherein the signal generator and the amplifier provide mechanical oscillation to the blade.

22. An ultrasonic cutting blade capable of bi-directional slitting of a food product without adhesion of said food product to said blade comprising:
a base portion having a first thickness; and
a cutting portion having a second thickness, said first thickness being greater than said second thickness;
said cutting portion having downwardly convergent cutting edges defining an included angle therebetween;
said included angle being between 60 and 90 degrees.

23. The ultrasonic cutting blade of claim 22 wherein said blade is tuned for oscillation at about 20,000 Hz. and is capable of cutting entirely through a slab of natural cheddar cheese having a height of 2.5 in. and a width of 10 in. at a linear velocity of over 18 in. per second across the width of said slab, leaving a cut surface that is smooth, shiny and free of burrs, and separating a portion of said slab from the remainder thereof, leaving the knife clean and smear-free, without fines or dust, with said blade being supported from above.

24. The ultrasonic cutting blade of claim 23 wherein said blade is capable of cutting said slab at a linear velocity of over 30 in. per second.

25. The ultrasonic cutting blade of claim 24 wherein said blade is capable of 150 cuts per minute through said slab.

26. A method of bidirectional slitting of a food product using an ultrasonically oscillating blade without adhesion of said food product to said blade comprising:
supporting said blade from above;
oscillating said blade at a frequency of about 20,000 Hz.;
driving the blade transversely through said food product in a first transverse direction in a first stroke to displace said blade from a first side of said food product to a second side of said food product, thereby forming a first cut through the food

product to sever a portion of the food product from the remainder of the food product, said driving being accomplished by applying lateral force to said blade with a movable support disposed above the food product;

advancing the food product in a forward direction; and

driving the blade transversely through said food product in a second transverse direction in a second stroke to displace said blade from said second side of said food product to said first side of said food product, thereby forming a second cut through the food product at a location spaced from said first cut to sever a second portion of the food product.

27. The method of claim 24 wherein said blade has inclined downwardly convergent cutting edges on opposite ends thereof and said slab has substantially vertical sides, so that an upper portion of each of said cutting edges engages said slab before a lower portion thereof engages said slab in each of said strokes.

28. The method of claim 25 wherein said blade cuts entirely through a slab of natural cheddar cheese having a height of 2.5 in. and a width of 10 in. at a linear velocity of over 18 in. per second across the width of said slab, leaving a cut surface that is smooth, shiny and free of burrs, and separating a portion of said slab from the remainder thereof, leaving the knife clean and smear-free, without fines or dust, with said blade being supported from above.

29. The method of claim 26 wherein said blade cuts said slab at a linear velocity of over 18 in. per second.

30. The method of claim 27 further comprising additional strokes alternating between said first and second directions wherein said blade makes over 100 cuts per minute through said slab.

31. The method of claim 28 wherein said blade makes at least 150 cuts per minute through said slab and achieves a linear velocity of at least 30 in. per second.